



Nymphaea alba var. *rubra* Lönnr. (Nymphaeaceae): a new record for the aquatic flora of Kashmir Himalaya, India

Afrozah Hassan¹, Shugufta Rasheed², Anzar A. Khuroo², Ather Masoodi¹, Irshad A. Nawchoo¹

1 Plant Reproductive Biology, Genetic Diversity and Phytochemistry Research Laboratory, Department of Botany, University of Kashmir, Srinagar-190006, Jammu and Kashmir, India. **2** Centre for Biodiversity and Taxonomy, Department of Botany, University of Kashmir, Srinagar-190006, Jammu and Kashmir, India.

Corresponding author: Afrozah Hassan, malikaafreen6@gmail.com

Abstract

Nymphaea alba var. *rubra* Lönnr. is reported for the first time from Dal Lake, Kashmir Himalaya, India. The taxonomic identification was confirmed based on rhizome, leaf and flower characters. A brief description and photographic illustrations of *N. alba* var. *rubra* are provided to validate the new distribution record for aquatic flora of this Himalayan region. A comparison of *N. alba* var. *rubra* with its allied taxon, *N. alba* var. *alba*, is provided to facilitate field identification.

Keywords

Biodiversity, delimiting characters, identification, taxonomy.

Academic editor: Amit Kumar | Received 12 April 2020 | Accepted 18 June 2020 | Published 3 July 2020

Citation: Hassan A, Rasheed S, Khuroo AA, Masoodi A, Nawchoo IA (2020) *Nymphaea alba* var. *rubra* Lönnr. (Nymphaeaceae): a new record for the aquatic flora of Kashmir Himalaya, India. Check List 16 (4): 841–845. <https://doi.org/10.15560/16.4.841>

Introduction

The genus *Nymphaea* L. comprises 50–60 species and is one the most diverse genera in the order Nymphaeales (Wiersema 1988; Mabberly 2017). The genus is divided into five subgenera: *Anecphya* Casp., *Brachyceras* Casp., *Hydrocallis* Planch., *Lotos* DC., and *Nymphaea* L., with each showing a distinct distribution (Conrad 1905). These are mostly perennial, rhizomatous, aquatic herbs distributed across the tropical and temperate regions (Cook 1990). The flower comprises of four sepals, 7–40 petals, 20–700 stamens, and 5–47 carpels, the latter forming a ring embedded in cup-shaped receptacular and appendicular tissue to which the appendicular organs are attached laterally. The upper surface of each carpel contributes a ray of stigmatic

tissue to the stigmatic disk, which tops the ovary, and this ray usually terminates abaxially in a free appendage termed as the carpillary appendage or carpillary style (Wiersema 1988).

From the Indian subcontinent, Hooker (1897) reported four species of *Nymphaea*: *N. alba* L., *N. lotus* L., *N. stellata* Willd., and *N. pygmaea* Aiton. Nearly a century later, Cook (1996) reported seven species from India: *N. nouchali* Burm. f., *N. alba* L., *N. candida* C. Persl, *N. odorata* Aiton., *N. tetragona* Georgi, *N. tuberosa* Paine, and *N. pubescens* Willd. Ansari and Jeeja (2009), in a monographic work on genus *Nymphaea*, reported 15 taxa from India. Recently, three additional taxa have been described from India: *N. manipurensis* Asharani

& Biseshwori, *N. manipurensis* var. *versicolor* Asharani & Biseshwori (Sagolsem and Thongam 2014), and *N. abhayana* Anurag & M. Chowdhury (Chowdhury and Chowdhury 2016). From the Kashmir Himalaya, till now seven plant taxa of *Nymphaea* have been reported: *N. alba* L. var. *alba*, *N. candida* C. Persl, *N. lotus* L., *N. mexicana* Zucc., *N. stellata* Willd., *N. teteragona* Georgi, and *N. tuberosa* Paine (Kaul and Zutshi 1967; Stewart 1972; Kak 1990; Khuroo et al. 2007).

The present study reports the occurrence *Nymphaea alba* var. *rubra* Lönnr as a new distribution record to the aquatic flora of Kashmir Himalaya, India. A detailed taxonomic description, photographic illustrations of diagnostic characters, and a comparison with its allied taxon, *Nymphaea alba* var. *alba* L. are provided to validate the new plant record and facilitate field identification.

Methods

During a recent floristic survey in Kashmir Himalaya, India, the authors collected specimens of a hitherto unknown *Nymphaea* taxon growing in the Dal Lake. Standard methods have been used for collection, drying, and further processing of the specimens (Bridson and Forman 1998). The specimens collected are deposited in the University of Kashmir Herbarium (KASH) with a proper voucher specimen number.

The fresh plant specimens were identified using relevant taxonomic literature (Ansari and Jeeja 2009; Dhkar et al. 2011). The geographic location of study site was obtained with a GPS receiver (Garmin GPSMAP 76CSX). The photographs of the diagnostic characters were taken with the help of a portable hand-held microscope (DINO Lite AM4515ZT4).

Results

Nymphaea alba var. *rubra* Lönnr.

Nymphaea alba var. *rubra* Lönnr. 1856: 124; Conard (1905: 179, Pl. 15), Mitra (1993: 435).

Figures 1A–H, 2

New records. INDIA • 1; Jammu and Kashmir, Srinagar District, Kobuter Khana, Dal Lake; 34°07'42"N, 074°52'34"E; 1583 m a.s.l.; 11. Oct. 2018, at 14:11 h; A. Hassan and A. Masoodi leg; floating; KASH 301.

Global distribution. The *Nymphaea alba* var. *rubra*, reported to be a hybrid between *Nymphaea alba* and *N. odorata* was first recorded from the north-eastern Indian state of Meghalaya (Dhkar et al. 2011), and now extends its distribution westwards in Kashmir Himalaya. *Nymphaea alba*, the paternal species is distributed from Europe to Western Himalaya; while as its maternal species, *Nymphaea odorata* is distributed in USA, Australia, Brazil and India.

Identification. Perennial herb, root 20–30 cm long; horizontal rhizome 20–50 cm long, 2–5 cm in diameter (Fig. 1A, B). Leaves ovate to orbicular, entire, 10–20 cm in

diameter, thick with impressed veins and without mottling, glabrous both adaxially and abaxially, cordate or sagittate at base; petiole 25–30 cm in length, reddish (Fig. 1C, D). Flower 5–20 cm in diameter (Fig. 1E). Sepals 4, lanceolate, 8 cm long, caducous or decaying after anthesis, sometimes indistinguishable from petals. Petals many, 6 cm long, pinkish, elliptic, gradually transforming into stamens (Fig. 1F). Stamens petaloid, anthers linear, introse, filament of inner stamens more or less as wide as anther (Fig. 1G). Carpels many, in one whorl, completely united (Fig. 1H).

Nymphaea alba var. *rubra* differs from *N. alba* var. *alba* (Fig. 1I–L; Table 1) in having leaves glabrous on both abaxial and adaxial side, while as in latter, the leaves are only abaxially glabrous. The petal colour in *N. alba* var. *rubra* varies and possesses different shades of red, while as in *N. alba* var. *alba* it is white to creamy yellowish. There is no report of seed set in *N. alba* var. *rubra* whereas its allied taxa *N. alba* var. *alba* sets seeds.

Discussion

The genus *Nymphaea* consists of showiest aquatic plants and has attracted the attention of botanists and plant enthusiasts (Kabatova et al. 2014). Kashmir Himalaya is well-known for its freshwater ecosystems which harbor rich aquatic flora (Kaul and Zutshi 1967; Kak 1990). The present study has reported one more addition, *Nymphaea alba* var. *rubra* to the aquatic flora of this Himalayan region. In fact, Dhkar et al. (2011) had previously reported this plant taxa from north-eastern Indian state of Meghalaya, which is located at a distance of 1700 km away from Kashmir Himalaya.

Dhkar et al. (2011), based on molecular studies, suggested that *N. alba* var. *rubra* is a hybrid between *N. alba* and *N. odorata*. In recent times, hybridization is considered to be an important factor for evolution of invasiveness in plants (Ellstrand and Schierenbeck 2000). The introduction, establishment and spread of invasive species is a global concern and is occurring at an accelerated rate (Khuroo et al. 2007; Chandra and Gerhardt 2008). Generally, aquatic ecosystems have greater impacts of invasion than terrestrial ecosystems. Invasive species are predicted to be the most important drivers of biodiversity loss in lake ecosystems (Sala et al. 2000; Khuroo et al. 2012). Besides having ornamental value, some species of the *Nymphaea* are notorious invasive weeds. Most of the invasive species are nearly impossible to eradicate once established in new habitats (Pimentel et al. 2005). At present, *N. mexicana* is the most problematic weed which has completely invaded major areas of the Dal Lake, in Kashmir Himalaya. The extensive spread of *N. mexicana* has drastically reduced the growing area of *Nelumbo nucifera*, an economically important plant species that provides livelihood to the local people. Therefore, the distribution records of new plant taxa help in predicting the future spread of the potential invasive



Figure 1. A–H. *Nymphaea alba* var. *rubra*. **A.** Habit. **B.** Rhizome. **C.** Adaxial surface of leaf. **D.** Abaxial surface of leaf. **E.** Flower. **F.** Petal. **G.** Stamen. **H.** Carpel. I–L. *Nymphaea alba* var. *alba*. **I.** Habit. **J.** Flower. **K.** Petal. **L.** Stamen.

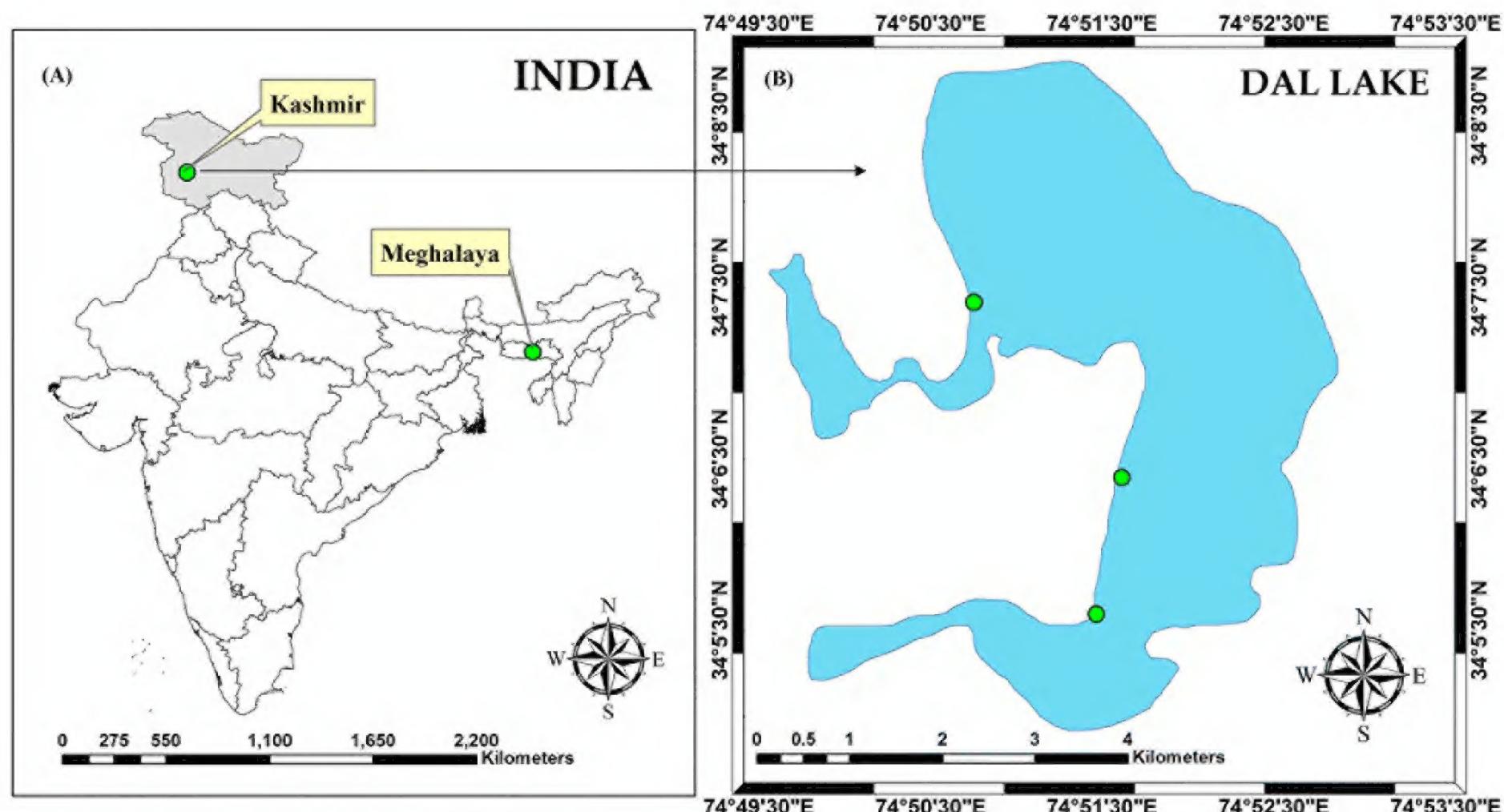


Figure 2. Location of previous and new records of *Nymphaea alba* var. *rubra* in India. **A.** Meghalaya **B.** Dal Lake, Kashmir Himalaya.

Table 1. Comparison of diagnostic characteristics of *Nymphaea alba* var. *rubra* with its allied taxa, *N. alba* var. *alba*.

Diagnostic characters	<i>Nymphaea alba</i> var. <i>rubra</i>	<i>Nymphaea alba</i> var. <i>alba</i>
Leaf	Angle	Entire and narrow cut just above the centre making an angle of 20°
	Pubescence	Glabrous abaxially and adaxially
	Colour	Turns from green to deep reddish
Flower	Diameter	10–15 cm
	Petal colour	Shades of red, outer petals light carmine red, inner one deep carmine red
	Anther size	Filaments of outer stamens longer than anthers
	Anther colour	Saffron red
Seeds		Does not produce seeds
		Entire and deep cut just above the centre making an angle of 30°
		Glabrous abaxially
		Remains green abaxially and adaxially
		10–20 cm
		White to creamy yellow; both inner and outer petals white in colour
		Filaments of outer stamens smaller or equal to length of anthers
		Yellowish
		Produce seeds

species and helps in taking timely action for management of aquatic ecosystems.

Acknowledgments

We are thankful to Head, Department of Botany, for providing necessary facilities, and to the supporting staff at the Centre for Biodiversity and Taxonomy, Department of Botany of the University of Kashmir, for their kind help during the present study. We acknowledge the useful comments made by two anonymous reviewers that improved the quality of the manuscript. This study has been financially supported by the Department of Science and Technology, Govt of India, New Delhi, under Task Force 5: Traditional Knowledge System - National Mission on Sustaining Himalayan Ecosystem, vide grant number: PAC-SES-DST-12141219-863, sanctioned to Irshad A. Nawchoo and Anzar A. Khuroo.

Author's contribution

The plant specimens were collected by AH and AM. Specimens were examined by AH, SR, AAK and IAN. Identified by SR and AAK. Manuscript was written by

AH, SR and AAK. AH and SR photographed the specimens and prepared figures.

References

- Ansari R, Jeeja G (2009) Waterlilies in India: taxonomy and cultivation of the genus *Nymphaea* L. (Nymphaeaceae). Indian Association of Angiosperm Taxonomy, Calicut, 86 pp.
- Bridson D, Forman L (1998) The Herbarium Handbook. Royal Botanic Gardens, Kew, 291 pp.
- Conard HS (1905) The Waterlilies, a monograph of the genus *Nymphaea* (Nymphaeaceae). The Carnegie Institute of Washington, Washington, DC, 279 pp. <https://doi.org/10.5962/bhl.title.51290>
- Cook CDK (1990) Origin, autecology and spread of some of the world's most troublesome aquatic weeds. In: Peiterse AH, Murphy KJ (Eds) Aquatic weeds: the ecology and management of nuisance aquatic vegetation. Oxford University Press, New York, 31–38.
- Cook CDK (1996) Aquatic and wetland plants of India. Oxford University Press, New York, 394 pp.
- Chandra S, Gerhardt A (2008) Invasive species in aquatic ecosystems: issues of global concern. *Aquatic Invasions* 3 (1): 1–2. <https://doi.org/10.3391/ai.2008.3.1.1>
- Chowdhury A, Chowdhury M (2016) *Nymphaea abhayana* sp. nov. of Nymphaeaceae from Duars of West Bengal, India. *International Journal of Plant Sciences* 5 (4): 57–60.
- Sagolsem AD, Thongam B (2014) Two new taxa of *Nymphaea* (Nymphaeaceae) from Meghalaya, India. *Check List* 10 (10): 2373–2377.

phaeaceae) from Manipur India. *Phytotaxa* 188 (2): 112–117. <https://doi.org/10.11646/phytotaxa.188.2.5>

Dkhar J, Kumaria S, Tandon P (2011) *Nymphaea alba* var. *rubra* (Nymphaeaceae) is a hybrid of *N. alba* and *N. odorata*, as evidenced by molecular analysis. *Annales Botanici Fennici* 48 (4): 317–324. <https://doi.org/10.5735/085.048.0403>

Ellstrand NC, Schierenbeck K (2000) Hybridization as a stimulus for the evolution of invasiveness in plants? *Proceedings of National Academy of Science of the United States of America* 97 (13): 7043–7050. <https://doi.org/10.1073/pnas.97.13.7043>

Hooker JD (1897) *Flora of British India*. Vol. 7. London Reeve and Co., London, 357 pp. <https://doi.org/10.5962/bhl.title.678>

Kabatova K, Vit P, Suda J (2014) Species boundaries and hybridization in Central European *Nymphaea* species inferred from genome size and morphometric data. *Persila* 86: 131–154.

Kak AM (1990) Aquatic and wetland vegetation of Kashmir Himalaya. *Journal of Economic and Taxonomic Botany* 14: 1–14.

Kaul V, Zutshi DP (1967) A study of aquatic and marshland vegetation of Srinagar. *Proceedings of the National Institute Sciences of India* 33: 111–127.

Khuroo AA, Rashid I, Reshi Z, Dar GH, Wafai BA (2007) The alien flora of Kashmir Himalaya. *Biological Invasions* 9 (3): 269–292. <https://doi.org/10.1007/s10530-006-9032-6>

Khuroo AA, Reshi ZA, Malik AH, Weber E, Rashid I, Dar GH (2012) Alien flora of India: taxonomic composition, invasion status and biogeographic affiliations. *Biological Invasions* 14 (1): 99–113. <https://doi.org/10.1007/s10530-011-9981-2>

Lönnroth KJ (1856) En röd neckros. *Botaniska notiser* 1856: 124–125.

Mabberley DJ (2017) Mabberley's plant-book: a portable dictionary of plants, their classification and uses. Fourth edition. Cambridge University Press, Cambridge, 1102 pp. <https://doi.org/10.1017/9781316335581>

Mitra RL (1993) Nymphaeaceae. In: Sharma BD, Balakrishnan NP, Rao RR, Hajra PK (Eds) *Flora of India*, 1. Botanical Survey of India, Kolkata, India, 430–431 pp.

Pimentel D, Zuniga R, Morrison D (2005) Update on the environmental and economic costs associated with alien invasive species in the United States. *Ecological Economics* 52 (3): 273–288. <https://doi.org/10.1016/j.ecolecon.2004.10.002>

Sala OE, Chapin FS, Armesto JJ, Berlow E, Bloomfield J, Dirzo R, Leemans R (2000) Global biodiversity scenarios for the year 2100. *Science* 287 (5459): 1770–1774. <https://doi.org/10.1126/science.287.5459.1770>

Stewart R (1972) An annotated catalogue of vascular plants of West Pakistan and Kashmir. Fakhri Printing Press, Karachi, 139 pp.

Wiersema JH (1988) Reproductive biology of *Nymphaea* (Nymphaeaceae). *Annals of the Missouri Botanical Garden* 75 (3): 795–804. <https://doi.org/10.2307/2399367>